

Restoration and Rebuilding of Forestry Ecological System in Heilongjiang Province¹

Nie Shaoquan (聂绍荃) Zhang Yanhua (张艳华) Zhu Hong (朱虹)

Northeast Forestry University, Harbin 150040, China

Abstract The study on restoration and rebuilding of forestry ecological system was conducted on Xianfeng Forestry Farm (N45° 03', E 129° 45'), in Yilan county, Heilongjiang province. One thousand hectare sample land was established. The research summarized the comprehensive technique measures: to managed virgin forests perfectly; to promote forest reforestation by artificial treatment; to restore the secondary forest with patch pattern; and to restore and foster felling land on artificial forest by means of natural pattern or close hillside to facilitate afforestation. The results showed that forest ecosystem function and quality were restored and rebuilt during ten years by utilization of these technique measures.

Key words: Forest ecological system, Restoration, Rebuilding

Introduction

Heilongjiang Province is one of the largest forestry regions in China, which is named as precious regions of forests deposits. Great amount of timber and many kinds of forest products have been produced there. The dense forests have provided natural defense for the succeeding high and stable yields of crops on the Songnen Plain and the Sanjiang Plain. But for a long time, the forestry has only been considered as one kind of industries and its characteristic of public welfare has often been ignored. The primary and old growth forests of Heilongjiang Province have been felled severely in large area. More than two-thirds of the these forests have turned into the secondary forests with low productivity, the shrub and the grassland. The quality and the function of the forest have dropped. Especially, for the timber forests, the stock of mature and overmature forests diminished greatly. The timber resources have been on the brink of exhaustion. The forest resources and the forest ecological environment worsened rapidly.

Thus, in more than 40 business of forest industry which belongs to Heilongjiang Province, the timber resources become to exhausted and the economic crisis started. The serious problem is that the protective function of forest weakened, the soil was eroded and the silt content of the river and brook increased. By account,

the height of riverbed increased at the average speed of 0.5~1.0 cm for every year. There are various natural calamity in Heilongjiang Province for every year. The function of Sanjiang forest ecosystem is also weak. According to the meteorological observation, the average air temperature in 1970 increases 0.1-0.5°C compared with that of tens years ago, the extreme climax temperature increases 0.1~0.7°C. The days of which the temperature is above 30°C increases 18 days. The precipitation drops from 670 mm (1956-1960) to 500-600 mm. The days with gale increases compared with that between 1959-1968. The wind speed increases from 26 m/s to 35 m/s. The variation of these meteorological factors reflects the decline in the forest ecosystem function.

Therefore, the results above show that forest quality of Heilongjiang Province drops, the area of primary and old growth forest diminishes. The function of forest ecosystem weakens. It is important to study the comprehensive technique on the recovery and the reconstruction of the deteriorated forest ecosystem in Heilongjiang Province.

Management Model and Countermeasure at Abroad

As the increase in population on a global scale, the

¹ This study is one part of research project in Seventh Five-Year plan and Eighth Five-Year plan.

diminishment in cultivated land and the increase in human living standard, people began to ask for more and more wealth from the nature resources. Thus, the resources crisis was aggravated and the ecosystem became fragile. According to the economy and the industry development standard of different country (or region), the characteristics of its natural geographical conditions and the destroyed degree of its forest ecosystem, and different models and countermeasures have been suggested for the recovery and the reconstruction of the deteriorated forest ecosystem

Sustainable development and permanent utilization

The important point is that the felling amount shouldn't exceed the growth amount of forests. The area of felling shouldn't be too large. The forest plantation should be regenerated and rebuild in time. Such as Sweden, USA, Japan and India have done.

Utilization of the integrative benefit of the forest

Integrative benefit means economic benefits, social benefit and ecological benefit. This kind of management model had been carried out in German and Austria since 1975. The forest economic benefit, social benefit and ecological benefit are merged into an organic whole. The forest circle is promoted well. It is favorable that the forest is restored at last.

Utilization of dominant function in various forest benefit.

This kind of model is that the forests are managed classifiably. The guiding principle is to get various forest ecological benefit. It has been used in France, New Zealand, Australia and Russia to restarted and rebuilt forest ecological system. Artificial mixed forests are planted in large area, and aimed species are grown for to build in this model. According to the function and the geographical distribution, the forests are divided into three types: timber forests, multifunction forests and ecological forests. In this model, the forests are managed classifiably, and its ecological benefit and social benefit are considered as dominant function. At the same time, the productivity is restored. The result showed that effect of this management mold is fine.

Agriforestry

At the same land, the agriforestry and the livestock farming are combined to form the permanent soil utilized system. In this model, the forests and the crops are rotated or planted with belt or patch pattern. Many developing countries used this kind of model to attain various forest benefit. In this model, the timber, the

crops and effect of the improvement environment can be obtained at the same time. Thus, it is a effective way that make full use of the soil, the space and the time.

New forestry

The thought of this kind of model was suggested by American scholars. The main idea is that the natural geographical landscape and the forest ecosystem are managed at the same time. When people want to fell the forests, they must fell the timber which can be used or not together. So the good and bad timber can be remained at the same time. The kind of model is a comprehensive measures that the ecological function and productive function of forest can be used integrally and ecological forestry systems is protected well. In this model, some snag is also reserved and provided niche for other organism. Therefore, the ecological function and productive function of forest are used in order to protect the diversity forest ecosystem.

Present Situation and Trend of Research in China

China is a country of lacking forests. The forest area of accounts for 4 percent of that of the world forest. The per capita amount is 0.12 hectare in forest area. On the basis of Plant Ecology, Ecosystem Ecology and Population Ecology, China has paid great attention to the recovery and the reconstruction of the forest ecosystem, and studied degeneration reason on the ecosystem, degeneration degree and its stage of succession. Therefore, the comprehensive technique and measures are obtained in preventing degeneration forest and rebuilding forest. Now, the area of artificial forests is great increase, but the component species is single. Generally larch is the main species of artificial forests in forestry region and its distribution area accounts for 70 percent of that of artificial forests. On plain, poplar is the main species of shelter-forests and it accounts for more than 90 percent of shelter-forests. Young poplar and birch are the main natural regeneration species. Although these species grow fast, they are short aged and lack resistance. Because of the unity species, the artificial forests lack resistance and its ecological function is weak. The other word, to fell forests is the major aim in the forest where belong to country, virgin forest and secondary forest. The felling amount is far over that of yielding, refreshment beyond felling make the felled large area becoming the secondary forest which hold low productivity and low economical value. In some land which destroyed seriously may be turn into the shrub and the herd. Therefore, it is urged to study on

the recovery and reconstruction of deteriorated forest ecosystem.

Substance Model and Countermeasure

Research on the reformation of the secondary forest is one part of the National Key Research Project in the Seventh five-year plan and Eighth five-year plan. The aim of this project is to change the primary and old growth forest, secondary forest, shrub and bent into the forest ecosystem which can provide not only timber but also various benefit for human .

Management and regeneration conducted at different forest layer by artificial treatment in the primary and old growth forest

This demonstration area covers 118hm². Every ten years, 15 percent of the upper storey is cut and 1410 m³ timber is produced. Then regeneration story or evolution story appeared. The main regeneration species are *Phellodendron amurense*, *Fraxinus mandshurica*, *Tilia amurensis*, *Acer mono*, *Pinus koraiensis* and *Picea koraiensis*. Rate of regeneration is over 30 percent. Forest space on patch pattern is 15%~20%, because forest over story is felled. Suitable space is provided for the under storey tree. The seedlings grow rapidly in the space of forest. So the layers of succession and regeneration have been formed now. Especially the seedlings of *Pinus koraiensis* are provided niche that the seedlings grew first in height, then in diameter. In this demonstration area, not only the timber can be produced, but also the diversity of the forest ecosystem can be recovered.

Artificial regeneration carried out with patch pattern in the secondary forest

This demonstration area covers 67hm². As to the exploitation, several empty niche is formed. The forest density is low Its distribution pattern isn't uniform and its stock amount is also low. In the gap of forest, *Pinus koraiensis* and *Pinus sylvestris* var. *mongolica* are planted to form the combined patch-pattern community which is mixed by artificial regeneration and natural regeneration. Thus, the terminal community pine forests mixed with broad-leaved trees can be recovered soon. In this demonstration area, the survival rate of artificial regeneration of *Pinus koraiensis* seedling and *Pinus sylvestris* var. *mongolica* seedling reaches 95 %. Remaining rate is 85 %. The growth amount of seedling in height raises 15% ~ 20. %. This conduction is fine to nature seedlings growing. The rate of natural seedling has also been rising 15% ~ 20 %. So, the effect of secondary forest regenerated is very well.

Regeneration carried out by means of natural reforestation pattern in felling land and artificial forest

This demonstration area covers 128hm². When the forest is felled, the sapling and the seed bank should be reserved .The rate of reserved sapling reaches 50%-60% and the main species are *Fraxinus mandshurica*, *Juglans mandshurica*, *Phellodendron amurense*, *Tilia amurensis*, *Picea koratensis* and *Abies nephrolepis*. Therefore, *Larix olgensis* is planted with belt pattern on land: 4,440 seedlings for per hectare, the distance of rows and trees is 1.5m× 1.5m for every seeding. The survival rate reaches 95%. Remaining rate is 85 percent after 3 years. Thus, the artificial and natural mixed forests have been formed. The key of management is the control of forest density in this demonstration area.

Management carried out with intensive pattern for the secondary forest of low productivity

This demonstration area covers 40hm². In this demonstration area, 10 %~15 % forest is assigned as commodity forest. The tree of low productivity is felled with belt pattern to provide suitable niche for others. In the mixed forest belt, such as mixed forest of *Larix olgensis* and *Tilia amurensis*, *Pinus koraiensis* and *Larix olgensis*, *Larix olgensis* and *Fraxinus mandshurica* are planted. The survival rate is 90%. The artificial regeneration layer has been formed. By the application of above techniques, the increment of secondary forest rose from 3.5 m³/hm² to 5 m³/hm². The productivity of forest rose 25% ~ 30%. The artificial forest has been reformed into mixed forest and the steadiness and resistance of forest ecosystem are raised.

Problems

The forest ecosystem provides not only timber but also survival ecological environment for human. The thought that the forest resources is inexhaustible and forestry means felling is wrong. The structure, function and dynamic rule of the individual tree, population, community and ecosystem of forest should be mastered and the forest should be managed according to natural rule .

There is a management problem in regeneration and recovering of forest system. It is not right that the forests are only afforested but not fostered. Otherwise, the results show that the preservative rate of national forest planting is only 39 % and forest ecosystem is frailed. The resistance of forest about nature is low. The preservative rate of national forest planting is just 39 percent and the forest ecosystem lacks resistance. Thus,

the forest preservation has become more and more important. If the forests were only afforested but not fostered, forest ecosystem was not recovered.

For a long time, the forestry has only been considered as timber production in China and its comprehensive benefit has been ignored. Some foreign scholars think that the forest ecosystem benefit is 3 or 20, even 50 times of timber. In fact, the ecological benefit of the forest is invaluable.

Suggestions

The secondary forest which accounts for 58.4 % of the forest area in Heilongjiang Province should be reformed as soon as possible. Now, the productivity of most secondary forest is low and its quality is not fine.

Therefore, it is important to manage the secondary forest, but it should be carried on gradually. The secondary forest resources is a kind of great economic and ecological wealth. The comprehensive necessary technique should be applied to reform the secondary forest.

The mixed forest should be adopted as the main type of artificial regeneration. More and more practice shows that the weakness of artificial pure forest is tremendous. On the contrary, the effect of mixed forest,

such as mixed forest of *Larix olgensis* and *Fraxinus mandshurica*, *Larix olgensis* and *Tilia amurensis*, coniferous pine forests mixed with broad-leave trees is fine. By this kind of artificial regeneration, the artificial forest of multispecies, multistructure, multifunction and multibenefit can be formed.

Artificial forest should be reformed by the control of density. During the management of artificial forest, the forest density can be reduced by artificial treatment. Other broad-leaved trees may be introduced. Gradually, mixed forest can be developed.

References

1. 聂绍荃. 关于黑龙江省次生林立体开发与合理经营的建议. 黑龙江林业调查. 1998 (4).
2. 聂绍荃等. 边缘效应理论在次生林改造中的应用. 东北林业大学学报 (生态专刊). 1990 (18).
3. 聂绍荃等. 发展农林混合业的依据与对策. 黑龙江省自然科学技术学术书. 科学技术文献出版社. 1996 (8).
4. 李景文主编. 黑龙江森林. 东北林业大学出版社. 1993 (9).
5. 姜恕等. 植被生态学研究. 科学出版社. 1994 (7).

(Responsible editor: Zhu Hong)